

9. Report on the Holothurians collected by Mr. J. Stanley Gardiner at Funafuti and Rotuma. By F. P. BEDFORD, B.A., King's College, Cambridge <sup>1</sup>.

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(Plates LII. & LIII.)

My thanks are due to Prof. F. J. Bell and Mr. J. Stanley Gardiner for giving me the opportunity of examining and describing the Holothurians collected by the latter at Rotuma and Funafuti in the S. Pacific. I have freely availed myself of the suggestions of both Prof. Bell and Mr. Gardiner, and am particularly grateful to the former for allowing me the use of a room to work in at the Natural History Museum, South Kensington, where I have been able to compare the specimens with the collection in the Museum, and where in consequence the task of identification has been much simplified. Prof. Bell, too, has kindly gone through the whole paper and corrected the proofs.

Any errors or shortcomings in the present paper I am of course solely responsible for.

The most generally useful books for the determination of *species* I found to be K. Lampert, 'Die Seewalzen,' in Semper's Reisen im Arch. Philipp. Bd. iv. 1885, and H. Théel, 'Challenger' Reports, pt. 39, *Holothurioidea*, ii. 1885.

The *genera* have undergone considerable revision since 1885, and the best recent diagnosis of the Holothuriidæ is given by Prof. Ludwig in Memoirs of Mus. of Comp. Zool. Harvard College, vol. xvii. no. 3, 1894, p. 37, which may be regarded as a supplement to his account in Bronn's Thier-Reich, Bd. ii. Abt. 3, Bde. i. 1889/92, pp. 327-361 <sup>2</sup>.

I have adopted this classification, with the single exception that I have followed Prof. Bell in substituting the name *Actinopyga* for *Mülleria* for the reasons stated by him (Ann. & Mag. Nat. Hist. xix. (1887) p. 392, and xx. p. 148).

The works by Dr. Lampert and Dr. Théel were in nearly all cases used in determining species, and I have therefore thought it unnecessary to repeat the references in each case in the text. I have been unable to obtain Dr. Sluiter's paper in Bijdrag tot de Dierk. Afl. xvii. 1895, entitled "Die Holothurien-Sammlung des Museums zu Amsterdam," and have had to rely on abstracts in Zool. Centralblatt, ii., and 'Zoological Record' for 1895; in all other cases I have had access to the original papers.

I have used the terms "dorsal" and "ventral" in the conventional analogical sense for "bivium" and "trivium" respectively.

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<sup>2</sup> Dr. H. Östergren (Öfvers. af Kgl. Vet.-Ak. Förhandlingar, lv. no. 2, 1898, p. 111) and M. Perrier (Comptes Rendus, t. cxxvi. no. 23, 1898, p. 1664) have somewhat amplified Prof. Ludwig's classification of the Synaptidæ and the Synallactinæ respectively.

In noting the horizontal distribution I have employed the terms used by Dr. A. E. Ortmann in his 'Grundzüge der marinen Tiergeographie,' 1896; in giving the size of specimens I have taken greatest length and greatest breadth.

The collection comprises examples of 12 species of *Aspidochirota*, 1 *Dendrochirota*, and 5 species of *Synaptidæ* (one of which is new); the following is a list:—

*List of Species.*

1. *Actinopyga* [*Mülleria*] *echinites* Jaeger ?, p. 836.
2. — [—] *mauritiana* Quoy & Gaimard, p. 835.
3. — [—] *parvula* Selenka, p. 836.
4. *Holothuria atra* Jaeger, v. *amboinensis* Semper, p. 839.
5. — *difficilis* Semper, p. 838.
6. — *fuscocinerea* Jaeger, var. *pervicax* Selenka, p. 837.
7. — *impatiens* Forskål, p. 840.
8. — *maculata* Brandt, p. 842.
9. — *monacaria* Lesson, p. 841.
10. — *pardalis* Selenka, p. 839.
11. — *rugosa* Ludwig, p. 839.
12. — *vagabunda* Selenka, p. 842.
13. *Pseudocucumis africana* Semper, p. 843.
14. *Synapta godeffroyi* Semper (genus *Euapta* Östergren), p. 847.
15. — *kefersteini* Selenka (genus *Chondrodea* Östergren), p. 847.
16. — *ooplax* v. Marenzeller (genus *Synapta* Östergren), p. 848.
17. *Chiridota intermedia*, sp. nov., p. 846.
18. — *liberata* Sluiter, p. 845.

As will be seen, I propose to combine *Actinopyga parvula* Selenka and *A. flavocastanea* Théel under the former specific name, and *Holothuria fuscocinerea* Jaeger et Semper with *Holothuria pervicax* Selenka.

Most of the species in the collection are widely distributed tropical forms, but I have thought it worth while to note any discrepancies between the individual specimens and the specific descriptions. The variations in the tentacles of *Pseudocucumis africana* Semper seem to be of interest from several points of view.

From the list of species it will appear that there is one which I believe to have been hitherto undescribed and which I have called *Chiridota intermedia*. As is well known, the species of *Chiridota* are very difficult to diagnose and separate from one another; the attempts that have been made to classify them on the minute structure of their wheels have not met with much success, and until more is known of the changes which take place during the growth of the individual, the specific differences must appear unsatisfactory—at any rate, the present species seems to be at least as definite as most others of the genus.

ASPIDOCHIROTÆ.

ACTINOPYGA MAURITIANA Quoy & Gaimard.

*Holothuria mauritiana* Quoy & Gaimard, Voyage de l'Astrolabe, iv. Zooph. 1833, p. 138.

*Mülleria varians* Selenka; E. Selenka, Z. f. w. Z. xvii. 1867, p. 310, Taf. xvii. figs. 4-9.

*Reference.* K. Lampert, Zool. Jahrb. Syst. Bd. iv. 1889, p. 813.

*Distribution.* Distributed over the Indo-Pacific region of the tropical zone from as far W. as Mozambique ('Alert') to as far E. as Society Is.

Two specimens from Rotuma, the largest being 91 mm.  $\times$  30 mm., seem to resemble in every respect the specimens collected by H.M.S. 'Challenger' and described by Théel, p. 201. They differ from the specimen described by Lampert from the Lucepara Is. in the absence of the arrangement of ventral feet in rows, although patches occur on the ventral surface, where the feet are less closely arranged than elsewhere.

#### ACTINOPYGA ECHINITES Jaeger.

*Mülleria echinites* Jaeger, De Holothuriis, pp. 17, 18.

*Reference.* Théel, 'Challenger' Holothurioidea, ii. p. 201.

*Distribution.* The species has been recorded from Fiji, Great Barrier Reef, Amboina, Thursday Is., Celebes, Sumatra, and Indian Ocean (Seychelles); it is thus fairly widely distributed over the Indo-Pacific region of the circumtropical zone. One specimen from Rotuma, 40 mm.  $\times$  15 mm., appears to belong to this species. It resembles Théel's description of the Fiji specimen in every particular except in colour, which is whitish brown with a few irregular dark patches on the dorsal surface; the ventral surface is lighter than the dorsal, and the tube-feet and papillæ are darker than the ground-colour.

The anal teeth are quite visible to the naked eye, and the deposits are like those described by Théel, except that they appear to have undergone a certain amount of solution and in consequence the identification is not certain.

#### ACTINOPYGA PARVULA Selenka. (Plate LII. figs. 1 a-d.)

*Mülleria parvula* E. Selenka, Z. f. w. Z. xvii. 1867, p. 314, Taf. xvii. figs. 17, 18.

*Mülleria flavocastanea* Théel; H. Théel, 'Challenger' Hol. ii. 1885, p. 198<sup>1</sup>.

*Distribution.* The species thus constituted is one of the most widely distributed circumtropical forms: it is recorded from the West African region (Madeira), East American region (Florida), and greater part of the Indo-Pacific from Seychelles Is. to Samoa, including the Red Sea.

A large number of specimens from Funafuti lagoon 20 fathoms and from the "mangrove swamp," largest about 25 mm.  $\times$  7 mm. As the specimens combine a number of characters of *A. parvula* and *A. flavocastanea* it seems worth while to describe them somewhat minutely. Théel has himself suggested the possibility that

<sup>1</sup> *Hol.* sp. n.,? juv., described by Ludwig (Zool. Jahrb. Syst. iii. p. 808, figs. 1-5), seems to be closely allied to this species, although no mention is made of anal teeth and it appears thus to be a true *Holothuria*.

*A. parvula* is the young of *A. flavocastanea*, and all the evidence seems to favour the identity of the two forms.

Colour uniform brown; number of tentacles 18 in one specimen (not countable in others).

Deposits agree almost exactly with Selenka's description and figures; the tables (Plate LII. fig. 1 *b*) are very crowded, frequently overlapping, and form a layer outside the buttons (fig. 1 *c*), which rarely possess less than 4 pairs of holes. The spiny rods mentioned by Selenka as occurring in the dorsal feet are very scarce (fig. 1 *d*), but sieve-plates (fig. 1 *c*) occur arranged in circles below the end-discs of the ventral and some of the dorsal feet.

The ventral feet are arranged in very distinct rows; dorsal feet much smaller and more papilliform and not arranged in rows; anal teeth five in number, small, and forming more or less irregular oval fenestrated plates, recalling the anchor-plates of some species of *Synapta*.

I could not make certain of the maturity of any of the specimens, but in one of the smallest, the only one of which I cut sections, ova were developed on the dorsal mesentery; the same specimen possessed one stone-canal completely embedded in the mesentery, two Polian vesicles, and tolerably well-developed tentacular ampullæ; Cuvierian organs were very well developed in all the specimens opened.

From the above description it will be obvious that the only points of distinction that can be maintained between *A. parvula* and *A. flavocastanea* are (1) colour and (2) size<sup>1</sup>, both of which may be due either 1) to age or (2) to local variation.

HOLOTHURIA FUSCOCINEREA Jaeger, var. PERVICAX Selenka. (Plate LII. figs. 2 *a*, *b*.)

*Holothuria pervicax* Selenka; E. Selenka, Z. f. w. Z. xvii. 1867, p. 327, Taf. xviii. fig. 54.

*Holothuria depressa* Ludwig; H. Ludwig, Arb. a. d. zool.-zoot. Inst. in Würzb. 1875, p. 108, Taf. vii. fig. 44.

*Holothuria mammiculata* Haacke; Möbins, Meeresfauna d. Ins. Maur. u. d. Seych. 1880, p. 48.

Var. of *H. fuscocinerea* Jaeger et Semper; G. F. Jaeger, De Holothuriis, 1833, p. 22; C. Semper, Reisen im Arch. Phil. Bd. i. *Hol.* 1867, pp. 88, 250, Taf. xxvii. & xxx. fig. 22=*H. curiosa* Ludwig; H. Ludwig, Arb. a. d. zool.-zoot. Inst. in Würzb. 1875, p. 110, Taf. vii. fig. 29.

References. H. Ludwig, Ber. Oberh. Ges. Wien, xx. 1883, p. 173.

H. Théel, 'Challenger' Reports, xxxix. *Hol.* ii. 1885, pp. 220-222.

*Distribution.* The species is widely distributed over the Indo-Pacific area, extending as far W. as Japan. Four specimens from

<sup>1</sup> From the Zool. Record, 1895, it appears that Sluiter has described a specimen of *A. flavocastanea* 20 cm. long.



Rotuma : (1) 50 mm.  $\times$  20 mm. ; (2) 64 mm.  $\times$  19 mm. ; (3) 45 mm.  $\times$  18 mm. ; (4) 47 mm.  $\times$  23 mm.

Deposits quite agree with Ludwig's later description (1883, *l. c.*) of *H. pervicax*; the tables have, as a rule, a rudimentary spire and are not frequent; in a small piece all the different forms of deposits from those typical of *H. pervicax* Selenka to those typical of *H. depressa* Ludwig can easily be found, a few approaching those typical of *H. fuscocinerea* Jaeg. (*v. fig. 2 b*).

This species, like *H. atra* Jaeg., has been repeatedly described under a new name on account of the great amount of variation to which its deposits are subject.

Like *H. atra* it seems to occur in two well-marked forms: var. (1), first described by Semper under the name of *H. fuscocinerea* Jaeg., and later by Ludwig as *H. curiosa*, in which the deposits consist of sparsely distributed tables (some, according to Théel, with more than one transverse beam) and somewhat irregular small buttons, which become more elongated in the ambulacral appendages; and var. (2), first described by Selenka under the name *H. pervicax* and later by Ludwig as *H. depressa*, which differs in the fact that the buttons are not so completely formed: in arrangement of ambulacral appendages, calcareous ring, and internal anatomy, the two varieties seem to be identical; in colour they differ slightly<sup>1</sup>. I have had an opportunity of examining some of Prof. Semper's original specimens, and those from Samoa which he describes as varieties of *H. fuscocinerea* (Semper, *l. c.* p. 250) agree in every respect with *H. pervicax*.

Ludwig (1883, *l. c.*) has shown that *H. pervicax*, *H. depressa*, and *H. mammiculata* should be associated together, and Théel (p. 221, *l. c.*) has suggested that *H. curiosa* and *H. fuscocinerea* are identical, a view in favour of which there seems to be considerable evidence.

*H. argus* Jaeger (*Bohedschia*) seems to be closely allied to this species.

#### HOLOTHURIA DIFFICILIS Semper. (Plate LII. fig. 3.)

*Holothuria difficilis* C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* 1868, p. 92, Taf. xxx. fig. 21.

*Distribution.* Recorded from Samoa, Amboina, Pulo Edam, and Mauritius.

Six specimens from Rotuma, largest 62 mm.  $\times$  20 mm., others about half this size.

The ground-colour of the smaller specimens is dark chocolate-brown.

They agree with Semper's short description and figures, to which I have nothing further to add; both the dorsal papillæ and ventral feet possess supporting perforated plates. Buttons, as a rule, with 3 pairs of holes.

The species appears to me to be much more closely allied to *Actinopyga excellens* and *A. parvula* than to *Holothuria vagabunda*.

<sup>1</sup> *v.* Semper, Taf. xxvii.

*HOLOTHURIA RUGOSA* Ludwig. (Plate LIII. fig. 4.)

*Holothuria rugosa* H. Ludwig, Arb. zool.-zoot. Inst. in Würzb. Bd. ii. 1875, p. 110, Taf. vii. fig. 33.

*Distribution.* Recorded from Samoa, Pelew Is., New Britain, Waigeo Island.

One specimen from Rotuma, 125 mm.  $\times$  22 mm., tentacular crown small (11 mm. in diameter). The five longitudinal furrows mentioned by Ludwig visible but not conspicuous, body flesh-coloured.

Deposits exactly as described and figured by Ludwig, but, as in the specimens described by Théel (p. 226), tables with more than 4 vertical supports to spire were exceptional.

*HOLOTHURIA PARDALIS* Selenka.

*Holothuria pardalis* E. Selenka, Z. f. w. Z. xvii. 1867, pp. 336, 337, Taf. xix. fig. 85; for synonymy, v. H. Ludwig, Sitzb. Ak. d. Wiss. Berlin, 1887, Heft 2, pp. 1226, 1227.

*References.* C. Ph. Sluiter, Natuurk. Tijd. v. Ned. Ind. xlvii. 1887.

H. Ludwig, Erg. d. Hamb. Magalh. Sammelreise, Lf. iii. 1898, p. 5.

In spite of Prof. Ludwig's separation of *H. subditiva* Selenka from *H. pardalis* Selenka, after Sluiter's examination of a large number of specimens from the Bay of Batavia all the evidence seems to point to the advisability of regarding them as one species, a view which has been upheld by Théel (as well as Sluiter).

*Distribution.* This species occurs all over the Indo-Pacific region from Zanzibar to Cocos Is., as well as in the East American littoral region (Surinam and Florida?). Prof. Ludwig (1887, *l. c.* p. 1242) described 2 specimens from Falkland Is., which would extend the range of the species into the Antarctic littoral region, but in 1898 (*l. c.*) he expresses some doubt as to the correctness of the locality recorded.

Several specimens from outer reef and mangrove swamp Funafuti: largest is 79 mm.  $\times$  10 mm., diameter of tentacular crown 7 mm. when expanded; another specimen 39 mm.  $\times$  9 mm., tentacular crown expanded 4.5 mm. in diameter; 20 tentacles (counted in 2 specimens). The specimens vary in colour in the way described by Sluiter. The buttons are very frequently incomplete and in those individuals examined they were irregularly distributed as in *H. subditiva*; the tables have, as a rule, a reduced spire, and their discs, which are invariably spinous, vary in size from .07 mm. to .04 mm. in diameter; curved rib-like rods occurred (as described) in the dorsal feet only.

*HOLOTHURIA ATRA* Jaeger, var. *AMBOINENSIS* Semper.

*Holothuria amboinensis* Jaeger, De Holothuriis, 1833, pp. 22, 23.

*Holothuria atra* Selenka; E. Selenka, Z. f. w. Z. xvii. 1867, p. 327, Taf. xviii. figs. 52, 53.

*Holothuria amboinensis* Semper; C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* p. 92.

Var. of *H. atra* Jaeger (Théel & Sluiter), which = *H. florilana* Pourtalès and Selenka and *H. affinis* (*Microthele*) Brandt.

*References.* L. G. Pourtalès, Proc. Am. Assoc. vol. v. 1851, pp. 12, 13.

H. Ludwig, Z. f. w. Z. xxxv. 1881, p. 596.

H. Ludwig, Ber. Oberh. Ges. xxii. 1883, pp. 170, 171.

C. Ph. Sluiter, Natuurk. Tijd. v. Ned. Ind. xlvii. 1887, pp. 187, 188.

C. Ph. Sluiter, Semon's Zool. Forsch. in Austr. u. Mal. Arch. Bd. v. Lf. i. 1894, pp. 103, 104.

Ludwig (*l. c.*, 1883) seems to have first suggested that the two forms of this species, which were separated by Semper and which were from that time considered to be distinct species, were in reality well-marked colour-varieties of the same species, indistinguishable by any constant anatomical characters. Var. *amboinensis* is uniform dark brown or black, whereas in the other variety, which may be termed var. *affinis* = *H. atra* Jaeger (Théel and Sluiter), the ends of the feet and papillæ are whitish. In 1887 (*l. c.*) Sluiter had been unable to find intermediates between the two forms, but in 1894 (*l. c.*) he describes such among 5 individuals from Amboina.

*Distribution.* Both varieties are extremely widely distributed over the Indo-Pacific region and occur also in the circumtropical East American littoral region.

Two specimens from Rotuma and several from outer reef and lagoon, Funafuti, all belonging to var. *amboinensis*.

In four specimens dissected the following organization occurred:—

Length.	Breadth.	Cuvierian organs.	Polian vesicles.	Stone-canals.	Gonads.	Locality.
mm. 37	mm. 10	Absent.	2, fairly large.	3 in a group.	Undeveloped.	Rotuma.
46	20	Ditto.	4, ditto (7-9 mm. long).	16 ditto, various sizes.	Ditto.	Funafuti, outer reef or lagoon.
84	22	Ditto.	2, united at base, one much smaller than the other.	8 in a group.	Very small.	Ditto.
104	27	Ditto.	1 (12 mm. long).	5 in a group (each about 5 mm. long).	Large, arranged like a tassel on one side of mesentery.	Ditto.

#### HOLOTHURIA IMPATIENS Forskål (*Fistularia*).

*Holothuria impatiens*, P. Forskål, Descriptiones Animalium, 1775, pp. 121, 122.

*Holothuria botellus* Selenka; E. Selenka, Z. f. w. Z. xvii. 1867, p. 335, Taf. xix. figs. 82-84.

*References.* C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* 1868, p. 82, Taf. xxii.

H. Ludwig, Arb. a. d. zool.-zoot. Inst. in Würzb. 1875, p. 112, fig. 51.

H. Théel, 'Challenger' Holothurioidea, ii. p. 179, pl. vii. fig. 9.

H. Östergren, Zool. Anz. Bd. xxi. 1898, pp. 233-237.

*Distribution.* This species is extremely widely distributed throughout the circumtropical zone; it is recorded from the East American region, Mediterranean subregion (Dalmatia &c.), and the greater part of the Indo-Pacific region.

Several specimens from Rotuma from 29 mm. × 11 mm. to 106 mm. × 23 mm.

The colour is characteristic, the dorsal violet-brown blotches, as a rule, coalescing to form transverse bands; but in one specimen the blotches are quite distinct, forming two longitudinal rows, as in the two specimens described by Ludwig from Tahiti and Surinam respectively.

The deposits are typical and I have no opportunity of confirming Östergren's view that *H. aphanes* Lampert is the young form of *H. impatiens* Forskål.

In four specimens dissected the arrangement shown in the following table occurred:—

Length.	Breadth.	Cuvierian organs.	Polian vesicles.	Stone-canals.	Gonads.	Locality.
mm. 106	mm. 28	Very bulky, white.	2 (each over 20 mm. long).	1, free.	Very large, with short thick branches.	Rotuma.
65 55	15 25	(Eviscerated.) Very bulky, white.	Ditto. Ditto.	Ditto. Ditto.	(Eviscerated.) Very large, with short thick branches.	Ditto. Ditto*.
29	11	Bulky, white.	1 (5 mm. long).	Ditto.	Undeveloped.	Ditto.

\* *Remark.*—Tentacle ampullæ long.

#### HOLOTHURIA MONACARIA Lesson.

*Holothuria monacaria* R. P. Lesson, Centurie Zoologique, 1830, p. 225, pl. 28.

*References.* H. Théel, 'Challenger' Holothurioidea, ii. 1885, pl. viii. fig. 10.

C. Ph. Sluiter, Natuurk. Tijd. v. Ned. Ind. Bd. xlvii. 1887, p. 189.

H. Ludwig, Zool. Jahrb. Syst. iii. 1888, p. 806.

*Distribution.* The species is widely distributed over the Indo-Pacific region of the circumtropical zone.



Several specimens from Rotuma, average about 40 mm.  $\times$  12 mm. The colour of all the specimens is very striking and constant (*v. Sluiter & Ludwig, l. c.*), the warts on which the papillæ are erected being distinctly yellow as described by Ludwig.

In three specimens dissected the following variations occurred:—

Length.	Breadth.	Cuvierian organs.	Polian vesicles.	Stone-canals.	Gonads.	Locality.
mm. 50	mm. 14	? (Eviscerated.)	1 (15 mm.).	1 (free for greater part).	? (Eviscerated.)	Rotuma.
36	13	Small.	2 (one much longer than the other).	Ditto.	Undeveloped.	Ditto.
30	11	Small.	2 (one little longer than the other).	Ditto.	Undeveloped.	Ditto.

#### HOLOTHURIA MACULATA Brandt.

(Genus *Sporadipus*, subgenus *Acolpos*) *v. H. Ludwig, Z. f. w. Z.* xxxv. 1881, p. 595.

*Holothuria arenicola* Semper; C. Semper, *Reisen im Arch. Philipp.* Bd. i. *Hol.* 1868, p. 81, Taf. xx., Taf. xxx. fig. 13, Taf. xxxv. fig. 4.

*Distribution.* Recorded from greater part of Indo-Pacific region and also from East and West American regions of circumtropical zone.

Two specimens from outer reef, and one from shore of lagoon, Funafuti, up to 126 mm.  $\times$  22 mm.; all quite typical (internal anatomy not examined).

#### HOLOTHURIA VAGABUNDA Selenka.

*Holothuria vagabunda* E. Selenka, *Z. f. w. Z.* xvii. 1867, Taf. xix. figs. 75, 76.

*Holothuria lagena* Haacke; H. Ludwig, *Ber. Oberh. Ges.* xxii. 1883, pp. 174, 175.

*References.* H. Théel, 'Challenger' *Holothurioidea*, ii. 1885, p. 180, pl. vii. fig. 10.

R. Koehler, *Mém. Soc. Zool. France*, viii. 1895, pp. 383, 384.

H. Ludwig, *Ergeb. d. Hamb. Magalh. Sammelreise*, Lf. iii. 1898.

H. Ludwig, *Fauna Chilensis*, Heft ii. p. 449.

Koehler, after examining specimens from different localities, proposed to unite *H. vagabunda* and *H. lagena*.

*Distribution.* This species is recorded from all over the Indo-Pacific region of the circumtropical zone, from as far E. as the Cocos Islands and Peru to as far W. as the E. of Africa: Lampert gives the locality Adelaide (Berlin Museum); and if this refers to

the port of that name in S. Australia it would extend its range into Ortmann's Antarctic littoral region, although Ludwig does not include the species in his list of Antarctic Holothurians.

One specimen, 140 mm.  $\times$  32 mm., from outer reef, Funafuti: colour uniform brown; the dorsal appendages distinctly more papilliform than the ventral; deposits typical; Cuvierian organs present.

#### DENDROCHIROTE.

*PSEUDOCUCUMIS AFRICANA* Semper. (Plate LIII. fig. 5.)

*Cucumaria africana* C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* p. 53, Taf. xv. fig. 16 (figure inaccurate, *v.* Ludwig, 1888).

*Cucumaria assimilis* Bell = *Ps. théeli*, Ludwig = *Ps. africana* Ludwig.

For more detailed synonymy, *v.* R. Koehler, Rev. Suisse de Zool. iii. 1895, pp. 276, 277.

*References.* H. Ludwig, Arb. a. d. zool.-zoot. Inst. in Würzb. 1875, p. 90, fig. 17 (*Ps. acicula*).

F. J. Bell, Proc. Zool. Soc. 1884, pp. 253-258 (*Amphicyclus japonicus*).

K. Lampert, Die Seewalzen, 1885, pp. 254, 255 (*Ps. intercedens*).

H. Ludwig, Zool. Jahrb. Syst. ii. 1887, pp. 25-27 (*Ps. intercedens*).

H. Ludwig, Sitz. k. Ak. d. Wiss. Berlin, 1887, Heft ii. pp. 1236-1241, figs. 12-16 (*Ps. théeli*).

H. Ludwig, Zool. Jahrb. Syst. iii. 1888, pp. 815-817 (*Ps. africana*).

H. Ludwig, Bronn's Klassen, Bd. ii. Abth. 3, Buch 1, 1889-92, p. 95, figs. 11, 12, and p. 348.

W. Bateson, Materials for Study of Variation, 1894, pp. 432-435.

H. Östergren, Zool. Anz. Bd. xxi. 1898, p. 135.

The genus *Pseudocucumis* was first defined by Ludwig (*l. c.*, 1875) on the single species *Ps. acicula*, and with a few alterations, necessitated by the subsequent description of other species, this definition was used by him in Bronn's 'Klassen' (*l. c.* p. 348) to include the genus *Amphicyclus* Bell.

*Distribution.* The genus, of which five species are known, is recorded from the circumtropical Indo-Pacific region, and from the west coast of Norway. *Ps. africana* has been recorded from as far W. as Zanzibar to as far E. as Fiji.

Seven specimens from Rotuma, averaging about 22 mm.  $\times$  9 mm.

I have nothing to add to Ludwig's full and accurate description (1887, *l. c.*, *Ps. théeli*), except to record certain variations in tentacular symmetry which appear to me of interest, especially in relation to the arrangements occurring in other species of the genus. *Ps. mixta* Östergren has 5 pairs of larger alternating with 5 pairs of smaller tentacles; the latter are radial in position and vary in size; they seem from Östergren's description to be arranged in bilateral

symmetry, except the mid-ventral radial pair, the left of which is smaller than the right: no mention is made of the tentacles forming more than one circle, but as they were in a retracted condition this may have been overlooked.

*Ps. acicula* Semper (Ludwig, 1875, *l. c.* fig. 17 *b*) also possesses 20 tentacles, of which 15 (10 large and 5 small) form an outer circle surrounding 5 smaller tentacles corresponding to the radii (*v.* Diagram I.) (from Bronn, *l. c.* p. 95).

*Ps. intercedens* Lampert.—Lampert (*l. c.*) describes 18 tentacles, of which 5 form an inner circle, the inner tentacles being as large

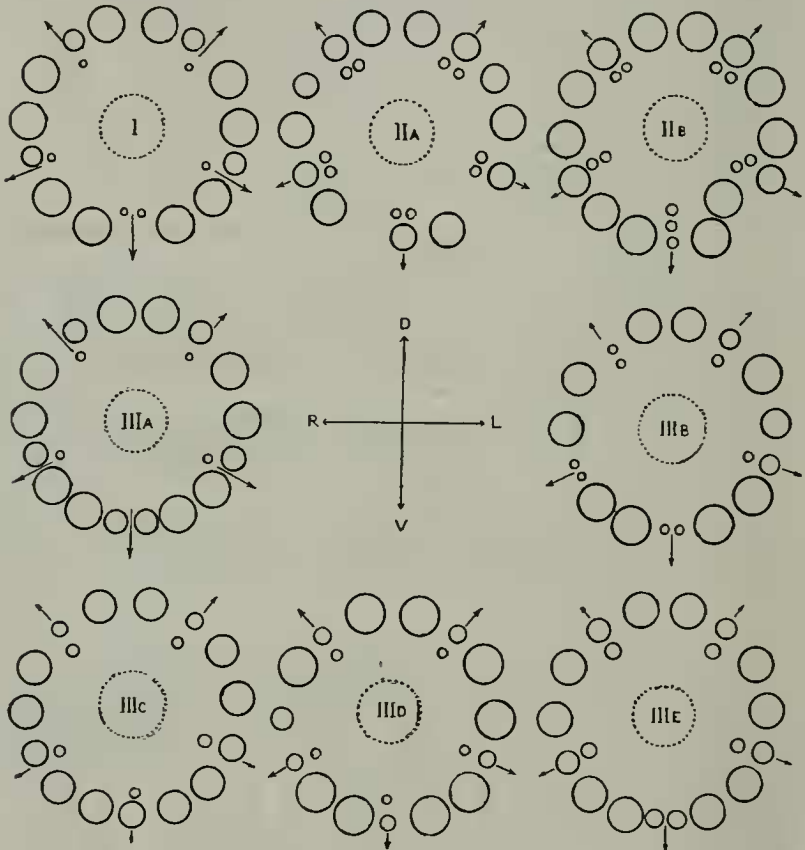


Diagram of oral tentacles of *Pseudocucumis*.

The tentacles are supposed to be viewed from in front, the mouth being represented in the centre. The relative sizes of the circles correspond approximately to the relative length and breadth of the tentacles, the relative distances being also approximately correct. The arrows indicate the position of the 5 radii.

Fig. I. *Pseudocucumis acicula* (Semper), after Ludwig in Bronn's 'Klassen,' *l. c.* p. 96.

Fig. II. *Ps. japonica* (Bell). A, B. From two specimens in the British Museum.

Fig. III. *Ps. africana* (Semper). A. After Ludwig in Bronn's 'Klassen,' *l. c.* p. 96; B, C, D, E. From specimens in the present collection.

as the smallest of the outer tentacles (if the inner circle consisted of 5 pairs, a condition similar to that which I found in a specimen of *Ps. japonica*, v. Diagram II., would result).

Ludwig (1887, *l. c.*) described a specimen in which the arrangement and number of tentacles were quite different, an inner circle of 5 pairs being surrounded by an outer circle of 20 larger tentacles arranged in 5 groups of 4, making 30 altogether.

*Ps. japonica* Bell.—In two specimens in the British Museum I find 25 and 23 tentacles respectively, arranged as in Diagrams II. A and II. B.

*Ps. africana* Semper possesses 20 tentacles. Ludwig (*l. c.*, 1887, *Ps. thélii*) described in two examples the arrangement shown in Diagram III. A, which is taken from Bronn, *l. c.* p. 95. 4 out of the 7 specimens were preserved in formol with expanded tentacles, and in these specimens the arrangement is as shown in Diagrams III. B, C, D, E.

The interest of these variations seems to me to lie chiefly in two directions: (1) the individual variations follow the same lines as the specific differences, and in consequence they indicate the sort of stages by which it is possible for one type of tentacular arrangement to be converted into other types without any "breaches of continuity"; and (2) the relation of the minor tentacular symmetry to the major symmetry of the body is seen in the bilateral symmetry of the tentacles combined with a radial and interradian arrangement.

It may be interesting to note the presence of developing Gastropod eggs, crowded in the usual mucoid (?) capsules, and fixed to the surface of one of the specimens: the capsules were circular in outline and rather more than 1 mm. across, each containing over 100 embryos; whether these belong to some parasitic genus, e. g. *Eulima* or *Stylifer*, or to a free-living form, I have no opportunity of discovering.

#### SYNAPTIDÆ.

##### CHIRIDOTA LIBERATA Sluiter.

*Chirodota liberata* C. Ph. Sluiter, *Natuurh. Tijds. v. Ned. Ind.* xlvii. 1887, pp. 212, 213, Taf. ii. figs. 44, 45.

*Distribution.* Sluiter's specimens were found creeping on dead or living branches of coral in the Bay of Batavia, and a single specimen is recorded from Pulo Edam.

One specimen from Rotuma, 28 mm. × 4 mm., 12 tentacles, each with 8 to 10 pinnæ, the two longest forming a terminal pair; wheel-papillæ in single row on two ventral interambulacra, distributed more numerous on 3 dorsal interambulacra as in *C. rigida*. Wheels .05 mm. diameter, owing to partial solution no details could be made out; no deposits in body-wall outside wheel-papillæ, but within the papillæ the characteristic C-shaped bodies figured by Sluiter occur; these at first sight appear like broken rims of wheels,



but are undoubtedly separate deposits: calcareous ring not closely examined; 5 short retractor muscles and several Polian vesicles occur.

CHIRIDOTA INTERMEDIA, sp. nov. (Plate LIII. figs. 6 a-d.)

*References.* H. Ludwig, Arch. de Biol. t. ii. 1881, pp. 41-58, pl. iii. (*C. rotifera*).

R. Semon, Mitth. a. d. zool. Stat. zu Neap. vii. 1887, p. 272, Taf. x.

H. Ludwig, Z. f. w. Z. liv. 1892, p. 350, Taf. xvi.

A. Dendy, Journ. Linn. Soc., Zool. xxvi. 1897, p. 49.

Several specimens from the mangrove swamp, Funafuti, average about 22 mm.  $\times$  4 mm.: largest under 3 cm. long. Colour whitish, transparent near posterior end of body. 12 or 13 tentacles (out of 4 individuals, 2 had 12 and 2 had 13); pinnæ subequal, about 7 in number, the proximal pinnæ being situated some distance from base, terminal ones *not* forming a pair longer than rest.

Wheel-papillæ in a somewhat irregular single row in each interambulacrum (except at anterior end, where they are more crowded); the two ventral interambulacra contain very few papillæ, being often quite devoid of them in the middle of the body (cf. *C. levis*); the papillæ are opaque, white, and rather conspicuous. Wheels and curved rods present. The wheels (figs. 6 a, b) are very similar to those of other species of *Chiridota*: a cover-plate is present over the basal plate and its centre is closed; there is no central pillar between the base and cover-plate; the upper rim only of the wheel is toothed, and there is a distinct notch in the cover-plate between its radii (= "Speichen-Platten," Ludwig). Dendy (*l.c.*) described the fully-developed wheels of *Trochodota dunedinensis* (*Chiridota dunedinensis* Parker) as situated with their faces parallel to the surface of the body, and so arranged that the toothed edge is always directed outwards; in consequence he uses the terms "outer" and "inner" faces of the wheels: in *C. intermedia* the arrangement is different; the wheels are arranged in each papilla so that the toothed edge of the wheel is nearly always directed away from the centre of the papilla, so that those wheels on the inside of each papilla have the toothed edges facing the opposite way to those on the outside of the papilla. It seems better, therefore, to use the arbitrary terms "upper" and "lower" in the sense in which Ludwig has already used them, so that they are applicable to any arrangement of the wheels in the body-wall. The rods (fig. 6 a) are present all over the body and are thickened at the ends and in the middle, the ends being unbranched except in the tentacles (fig. 6 d), where they are also longer and narrower (cf. *C. liberata* and *C. rotifera* and tentacular deposits of *C. pisanii*); abnormalities of the rods occasionally occur either by the development of a branch from the middle of the rod forming a triradiate spicule, or they may very rarely become S-shaped, a condition which is normal in *C. contorta*, *C. australiana*, *Trochodota purpurea* (= *studer*), and *Anapta*

*japonica*. Calcareous ring consists of 12 pieces, 5 radial and 7 interradial, the latter being arranged symmetrically on each side of the dorso-ventral line (1 in each ventral interradius, 1 in mid-dorsal interradius, and 2 in each dorso-lateral interradius); the 5 radial pieces are each pierced by a hole (or seldom notched as in *C. liberata*). Several Polian vesicles (about 5) and a single stone-canal fixed to mesentery occur.

SYNAPTA GODEFFROYI Semper.

(Genus *Euapta* Östergren), C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* p. 231, Taf. xxxix. fig. 13.

*Reference.* C. Ph. Sluiter, Semon's Zool. Forsch. in Austr. u. Mal. Arch. Bd. v. Lf. 3, 1894, p. 105.

*Distribution.* Mauritius, Pelew Is., Thursday Is., Fiji, Samoa, Caroline Is.; it thus ranges over a considerable part of the Indo-Pacific region.

Two specimens from Rotuma: largest 180 mm.  $\times$  13 mm., length of tentacles about 13 mm.; 15 tentacles.

Deposits &c. agree with description and figures by Semper, but the malformations of the anchors did not seem to occur (*cf.* Sluiter):

Two smaller specimens from Rotuma, one of which is 35 mm.  $\times$  5 mm., appear to be the young of this species: the tentacles I am unable to count because of their condition, but the deposits agree exactly with the larger forms; colour is different, the body being speckled with silver-grey markings.

SYNAPTA KEFERSTEINI Selenka.

(Genus *Chondrodea* Östergren), E. Selenka, Z. f. w. Z. xvii. 1867, p. 360, Taf. xx. figs. 120, 121.

*References.* C. Semper, Reisen im Arch. Philipp. Bd. i. *Hol.* pp. 14, 15, Taf. v. fig. 24, p. 230, Taf. xxxix. fig. 11.

H. Ludwig, Zool. Jahrb. iii. Syst. 1888, p. 818.

C. Ph. Sluiter, Semon's Zool. Forsch. in Austr. u. Mal. Arch. Bd. v. Lf. 3, 1894.

H. Östergren, Öfvers. af Kongl. Vet.-Ak. Förhandlingar, Årg. lv. No. 2, 1898, p. 111.

*Distribution.* Recorded from Sandwich Is., Samoa, Amboina, and Kosseir (Red Sea).

Two specimens (one imperfect) from Rotuma, one 70 mm.  $\times$  10 mm.

Ludwig (*l. c.*) notes the variation in number of tentacles in this species. In these specimens there are 25 in each specimen.

I have nothing to add to the description of Selenka and Semper, revised by Ludwig: in Ludwig's specimens the seventh hole of the anchor-plates has a dentate margin, whereas in those examined by Selenka and Semper the margin appears to have been smooth: these specimens are interesting in the fact that they possess anchor-plates of both kinds, intermediate conditions of all grades being very common.

## SYNAPTA OOPLAX Marenzeller.

*Synapta ooplax* v. Mar. Verh. zool.-bot. Ges. Wien, xxxi. 1881, pp. 122, 123, Taf. iv. fig. 1.

*Reference.* H. Östergren, Zool. Anz. Bd. xxi. 1898, pp. 233-237.

*Distribution.* Recorded from Japan and Loyalty Is.

Three specimens from beach of lagoon, Funafuti; largest 135 mm.  $\times$  5 mm.

The body is nearly circular in section, with the radii visible as 5 white indistinct longitudinal bands; colour whitish, without the pink tinge which typically characterizes the species.

In one specimen the deposits were quite typical, in the second they were completely dissolved, and in the third somewhat disintegrated, anchors alone were present (no anchor-plates or biscuit-shaped spicules); I believe this condition to be due to partial artificial solution, but as Sluiter has described for *Synapta kefersteini* a somewhat similar condition of partial decalcification, which he believes to be natural, it seemed worth while to mention the fact; Östergren has also laid stress on a similar process taking place in other Holothurians.

## EXPLANATION OF THE PLATES.

## PLATE LII.

Fig. 1. *Actinopyga parvula* Selenka, p. 836.

a. Entire ventral view.  $\times$  4.

b. Tabular deposits.  $\times$  250.

c. Button-like deposits and sieve-plates.  $\times$  250.

d. Spiny rods in the dorsal feet.

Fig. 2. *Holothuria fuscocinerea*, var. *pervicax* Selenka, p. 837.

a. Entire side view.  $\times$  1½.

b. Deposits (excluding tables).  $\times$  250.

Fig. 3. *Holothuria difficilis* Semper, p. 838. Entire side view. Nat. size.

## PLATE LIII.

Fig. 4. *Holothuria rugosa* Ludwig, p. 839. Entire side view. Nat. size.

Fig. 5. *Pseudocucumis africana* Semper, p. 843. Entire side view.  $\times$  3.

Fig. 6. *Chiridota intermedia*, sp. nov., p. 846.

a. Wheel from below.  $\times$  850.—The teeth on the upper edge are seen through the rim and the centre of the basal plate is shown in focus. *bp.*, basal plate; *cp.*, cover-plate; *cpc.*, centre of cover-plate; *cpr.*, radius of cover-plate; *ue.*, upper edge of wheel (toothed); *le.*, lower edge of wheel (smooth); *bpr.*, radius of basal plate; *sp.*, spoke of wheel between point of junction of *cpr.* and *bpr.* and rim of wheel; 1-6 opposite ends of spokes seen on rim of wheel.

b. Wheel on edge, same lettering as *a.*  $\times$  850. The basal plate (*bp.*) is seen dimly through the cover-plate (*cp.*) in the centre.

c. Rods in body-wall.  $\times$  300.

d. Rods in tentacles.  $\times$  300.